Claims

1. An instrument for studying an object, comprising an interferometer having a source of coherent object light and a source producing a reference beam which is coherent with the object beam, and a detector or a plurality of detectors arranged in an array, in which: the coherent light source is expanded and arranged to direct a converging object beam towards a point beyond the object and to produce a reflected object beam reflected from the object; a speckle pattern of light representing the effects of the reflection from the object, which is detected by the detector or the detector array.

2. An instrument as claimed in Claim 1, in which the object beam and the reference beam are coherent laser beams.

3. An instrument as claimed in Claim 2, in which the object beam and the reference beam are derived from a common laser source.

4. An instrument as claimed in any preceding Claim, in which the light source is arranged to converge the object beam towards a point which is approximately the same distance beyond the object as the object is spaced from the source.

5. An instrument as claimed in any preceding Claim, which is movable relative to the object.

6. An instrument as claimed in Claim 5, in which the speed of movement of the instrument, the sampling rate of the detectors and size of the area of the object illuminated by the converging object beam are arranged so that sequential areas of the object studied overlap.

7. An instrument as claimed in Claim 5 or Claim 6, in which the array of detectors is relatively narrow in the direction of movement and relatively long in the transverse direction.

8. An instrument as claimed in any preceding Claim, including one or more additional detectors or arrays of detectors.

9. An instrument as claimed in Claim 8, in which the detector or detector arrays are arranged in a line extending in the direction of movement of the instruments.

10. An instrument as claimed in Claim 8 or Claim 9, including means for generating one or more additional converging laser beams.

11. An instrument as claimed in Claim 10 in which there are three detectors or detector arrays, each arranged to detect a speckle or speckle pattern of light reflected from a respective laser beam.

12. An instrument as claimed in Claim 10 or Claim 11, in which the three detectors or detector arrays are arranged to have three different sensitivity directions.

13. A method of conducting an interferometric study of an object which comprises: deploying an instrument as claimed in any of Claims 1 to 12 in the vicinity of the object; directing a converging object beam of coherent light from the expanded source on to the surface of the object; moving the instrument relative to the object while maintaining a substantially constant distance between them, whereby the beam tracks across the surface of the object; combining the reflected object beam with the reference beam thereby

producing a speckle pattern; detecting at intervals a single speckle or the speckle pattern using a the single detector or the detector array; comparing sequential intensities in the speckle or speckle patterns detected in order to identify changes in the intensity of the speckle patterns; and creating a set of data representing the changes.

14. A method as claimed in Claim 13, in which the converging object beam and reference beam are laser beams.

15. A method as claimed in Claim 13 or Claim 14, in which any changes of intensity identified in sequential speckles or speckle patterns are associated with movements of the surface of the object.

16. A method as claimed in any of Claims 13 to 15, in which the point at which the converging object beam is arranged to converge to a point or line approximately the same distance beyond the object as the object is spaced from the source.

17. A method as claimed in any of Claims 13 to 16, in which the speed of movement of the instrument, the sampling rate of the detectors and size of the area of the object illuminated by the converging object beam are arranged so that sequential areas of the object studied overlap.

18. A method as claimed in any of Claims 14 to 17, which comprises directing one or more additional converging object laser beams on to the surface of the object combining the respective reflected object beams with a reference beam, and detecting the resulting speckle intensity or speckle pattern intensity using respective detectors or detector arrays.

19. A method as claimed in Claim 18, in which the detector arrays have different sensitivity directions.

20. A method as claimed in Claim 18 or Claim 19, in which the various laser beams are directed to different areas on the surface of the object.

21. A method as claimed in any of Claims 13 to 20 in which the movement of the instrument and any incidental displacements of the instrument are filtered out of the data.

22. A method as claimed in any of Claims 13 to 21, further including the step of generating a seismic event, whereby movements in the surface of the object represent responses to the seismic event.

23. A method as claimed in Claim 22, in which the object is the sea bed.

24. A method of conducting a seismic survey which comprises: generating a seismic event, applying the seismic event to the earth's surface; deploying in the vicinity of the earth's surface an instrument comprising means for generating a plurality of expanded and converging object beams of coherent light from one or more sources, means for generating a plurality of reference beams which are spatially and temporally coherent with the respective object beams, and a plurality of corresponding detector arrays; directing the converging laser beams on to the surface of the earth to produce reflected object beams; moving the instrument relative to the earth's surface at a constant distance above the earth's surface whereby the source beams track across the earth's surface; combining the reflected object beams with the respective reference beams to produce a plurality of respective speckle patterns; detecting at intervals the speckle patterns using the detector arrays; comparing, for each

object beam, sequential speckle patterns detected in order to identify changes in the intensity of the speckle patterns resulting from movements in the earth's surface in response to the seismic event; and creating a set of data representing the changes.

25. A method as claimed in Claim 24, in which the object beams and reference beams are laser beams.

26. A method as claimed in Claim 24 or Claim 25, in which the object beams are directed to different areas on the surface of the object.

27. A method as claimed in any of Claims 24 to 36, in which the detector or detector arrays have different sensitivity directions.

28. A method as claimed in any of Claims 24 to 27 in which the seismic event is applied to sea bed and the instrument is deployed in the vicinity of the sea bed.

29. A method as claimed in any of Claims 24 to 28, in which the movement of the instrument and any incidental displacements of the instrument are filtered out of the data.

30. A method of producing a seismic survey report of a region which comprises: carrying out a method as claimed in any of Claims 24 to 29, analysing the set of data to derive representations of underlying strata, and assembling the representations as a depiction of the geological nature of the region.